



## APPENDIX D-

### Preliminary Capital and Operating Cost Estimates

#### Methodology for Determining Capital Costs Methodology and Assumptions

##### **BACKGROUND**

This section describes the approach, source data, qualifying cost benchmarks and assumptions for developing the cost analysis for the Initial Segment of the Streetcar. Quantity data for the Cincinnati Streetcar Project was obtained from a variety of sources, including:

- “Operating Plan and Key Assumptions of Study Alignment” dated April 27, 2007
- Telephone conversations and e-mail exchanges with the HDR/PB project management team
- Other resources provided by the project team
- Prior experience with built projects similar in scope

The project team based the capital cost data base on other streetcar projects, including the Central Ohio (Columbus) Transit Authority's North Corridor Transit Project, the Madison [WI] Streetcar Feasibility Study and the West Sacramento (CA) Downtown/Riverfront Streetcar studies. Line-item specific cost data from the Tucson Streetcar project was also used to develop some of the allocations. In addition, the extensive capital cost library maintained by HDR and PB was also consulted to corroborate or modify particular costs used in the sources cited above. Costs were also benchmarked against recent bid experience on similar streetcar projects. At this level of planning, these are considered a definitive basis for cost estimating.

If the scope of work and cost basis from the baselined projects was not in exact agreement for a particular line item for this Streetcar project, the more conservative of the unit prices was used. This provides a further margin contingency given the preliminary nature of this project. Uncertainty about scope or unit costs is reflected in larger contingency percentages on work items that have less specificity, are poorly defined, or unknown at this time.

The cost of the streetcars proposed in this application can be purchased on an existing contract at a verifiable price at this time. A smaller contingency was used as a result. However, utilities are less well understood, therefore a more generous unit price and a larger contingency were applied. One exception to this was in the estimated cost for the Maintenance and Storage Facility (MSF) where costs for the Madison, West Sacramento and Tucson projects varied widely. In this instance, a conceptual cost for the Cincinnati facility based on size and a defined scope for this





application was developed and its cost estimated. The project team felt this to be the most reasonable approach.

The draft capital costs for the Cincinnati Streetcar Project are reported in the Federal Transit Administration's Standard Cost Category (SCC) format. The SCC format is highly-summarized, further substantiating the need for the methodology proposed.

Project Team input corroborated an initial determination of the one-way line length on the order of 3.9 miles. An additional 0.1 miles was allotted for a passing siding/holding track at the junction with the MSF lead. It was further determined that the MSF could be up to 0.5 miles away from the revenue track. The sum of these three elements led to the determination that there could be as much as 4.5 miles of track, as identified in some of the entries/calculations on the SCC "Main Worksheet." A further 0.2 miles of paved track were included to reflect the requirements for track in and around the MSF. This results in 4.7 miles of track in total, as shown where appropriate on the "Main Worksheet."

There are 3.9 miles of "revenue track" and a total constructed track length of 4.7 miles, providing a further cushion on actual track length and costs.

In the absence of any definitive implementation schedule, it was presumed that the project would begin revenue operations in 2012, with the project forecast year being 2025. The significance of the revenue operations date is that it determines over how many years the base year and year of expenditure totals can be divided.

## **METHODOLOGY**

### **Category 1 – Guideway and Track Elements**

**1.03 – Guideway: At-grade in mixed traffic** – This cost element covers the basic roadway demolition, removal and disposition of demolition rubble, and concrete reconstruction cost for the in-street trackbed, which comprises the 3.9 miles of mainline single-track, the 0.1 mile of siding/holding track and the 0.5 miles of track leading to the MSF. A unit price of \$180 per l.f. was applied similar to that used on other recent streetcar projects. This results in a base year cost of just under \$4.3 million.

**1.10 – Track: Embedded in-street trackbed** – This cost element covers the 4.7 miles of track in paving (mainline, siding/holding, MSF lead track and track within the MSF). A unit price of \$510 per l.f. was used to reflect local conditions, (this is not far removed from the range used on the Madison, Tucson and West Sacramento projects). This resulted in a base year cost of almost \$11.9 million.

**1.12 – Track: Special (switches, turnouts)** – A total of 15 switches are required on the Cincinnati Streetcar – four at the crossing of the line at 12<sup>th</sup>/Race (to facilitate short-turns, etc.), four at the "MSF Junction" (siding/holding track and lead track) and seven within the MSF. The unit cost of





\$160,000 was taken from the Madison project and applied to this estimate. This results in a base year cost of \$2.4 million.

**1.13 – Track: Vibration and noise dampening** – This line item was incorporated in earlier versions of the FTA's SCC template to include an additional allocation for unique reconstruction requirements. The bridges for the streetcar line over Fort Washington Way, 2<sup>nd</sup> Street, Main Street and Walnut Street are designed and built to accommodate LRT tracks. However, subsequent discussion has led to the elimination of this additional allocation, based on the presumption that the tracks will be located where the block-outs were poured during the original construction of the Ft. Washington Way bridge structures. The removal of the blockouts is accounted for in the demolition costs described in 1.03 Guideway: At-grade in mixed traffic.

## **Category 2 – Stations, Stops, Terminals**

**2.01 – At-grade station, stop or shelter** – The concept for the stations, stops, and shelters for the Cincinnati Streetcar are curbside facilities (a slight raising of the curb line in the sidewalk area, etc.) with limited intrusion into the adjacent pavement, sidewalk, or building entrances. These resemble an upgraded transit stop but do not have the amenities of an LRT station. Basic signage, illumination, and ticketing provisions are assumed. The Madison project used a unit price of \$75,000 for street side stops, while the Tucson project allowed \$150,000 per station. This was averaged to \$125,000 for the Cincinnati project to provide for arts-in-transit and other unique treatments to increase the attractiveness and identity of this transit facility. Basic signage, lighting, simple shelters, infrared heaters, benches, waste cans, bike racks and other amenities typical of modern transit installations are incorporated in the station/stop design. A total of 18 stops are required. The base year total cost is just under \$2 million.

## **Category 3 – Support Facilities: Yards, Shops, Administration**

**3.02 – Maintenance and Storage Facility** – The estimating approaches used for the Madison and West Sacramento projects lead to two, very different results when adjusted for the anticipated quantity of streetcars required for the Cincinnati operation. Using the Madison allowance would result in a Cincinnati MSF price of \$7 million, while the Sacramento allocation would result in a base price of \$1.5 million. In the case of the Tucson project, a cost of \$5.7 million was used for a nine-vehicle facility. On the basis of these inputs, an overall cost of \$5 million was used for the six-vehicle MSF needed to support the proposed Cincinnati Streetcar.

## **Category 4 – Sitework and Special Conditions**

**4.02 – Site Utilities, Utility Relocation** – Utility relocations are limited to the in-street, embedded guideway needed to install the tracks. This about 6 ft. wide, therefore only utilities which have boxes, manhole covers, or other components in the excavated area need to be relocated. This is a much less intrusive relocation effort than that used for LRT in-street construction. Specific details on relocation of public and/or private utilities was beyond the scope of this effort. An allocation of \$850,000 per mile was used, resulting in a base year cost of \$3.4 million. Because this item has the greatest uncertainty, therefore risk, of any of the cost elements in the Streetcar project a larger





base unit cost was used than found in other Streetcar projects. Accordingly, in the calculations for the contingency (Category 10), a 25% contingency has been applied to the utility relocation cost to reflect the level of uncertainty in this particular component of the scope.

#### **4.03 – Hazardous material, contaminated soil removal/mitigation, ground water treatments –**

No allocation has been made for any hazardous material removal or mitigation at the MSF site. No special drainage allowance on this project is provided as the surface drainage is already installed in the City's streets' curb and gutter.

### **Category 5 – Systems**

**5.02 – Traffic signals and crossing protection** – This cost element covers the cost of six new traffic signals to accommodate special cycles for the streetcar operation. The Sacramento streetcar project used a unit cost of \$120,000 per modified signal, while the Madison project allocated only \$75,000 for this work. Project staff input indicated that a reasonable new signal cost for the Cincinnati project would be \$100,000 per signal, with a base year cost of \$600,000 for the six signals. Note that these signals would be tied in to the City's existing traffic control system and would include signal preference for the Streetcar.

**5.03 – Traction power supply: substations** – The "Operating Plan and Key Assumptions" recommends substations for the Cincinnati Streetcar on a 1.0 mile spacing. This would result in four being required on the mainline/MSF lead trackage, with a ninth provided at the MSF site. However, subsequent input directed an increase in the number of substations on the mainline to five and one for the MSF. The unit cost for substations on both the Madison and West Sacramento projects was \$500,000. In the case of the Tucson project, the average price was \$550,000 per substation. The Tucson price was applied to the revised quantity, resulting in a base year cost of \$3.3 million for six substations.

**5.04 – Traction power distribution: catenary** – The Madison and West Sacramento Streetcar projects used a unit cost of \$200 per l.f. for traction power catenary poles and overhead wire. This unit price was applied to the 4.7 miles of track, including an adjustment for closer pole spacing around special work and in the MSF, a base year cost of \$5.1 million resulted.

**5.05 – Communications** – No equivalent unit cost was included in either the Madison or West Sacramento estimates. The Columbus streetcar alternatives analysis did include this line item, at an average unit cost of \$1.6 million per mile. However, this result was considered excessive for the simplified nature and operation of the Cincinnati Streetcar. An overall communications and central control system allocation of \$2.5 million was used for the base year cost. This allocation is intended to provide some flexibility for the project. It reflects an expectation that any control or communications equipment required for the Streetcar project would be installed at the MSF, the existing facility within the Riverfront Transit Center (RTC) Operations Center, SORTA's Operations Center, or at the City's Traffic Control Center. Further, it is presumed that SORTA's "Next Bus" stop enunciators and automatic vehicle location (AVL) systems can be expanded to include the Streetcar vehicles and stops. On-board AVL equipment for each Streetcar is covered in the per-





car cost estimate (Category 7, below). As the plans for this project are advanced, this allocation will be adjusted or scope limited to the budget provided.

**5.06 – Fare collection system and equipment** – Neither the Madison or West Sacramento estimates included a line item for fare collection. However, the Columbus streetcar alternatives analysis included this line item. An average unit cost of \$220,000 per station resulted, more than would be required for the Cincinnati application. For example, if two ticket vending machines were provided at each station (at a cost of \$80,000 per machine), this would result in a base year cost of just under \$2.9 million. Two TVMs per station are provided to ensure redundancy in the event of failure of one machine. If only one machine were provided per station, no fares would be collected at that station from the time that lone machine failed, until such time as it was restored to service. Further, the \$80,000 per TVM allocation provides remote status reporting and health monitoring, which should expedite repair or restocking activities. Note that this allocation provides for considerable flexibility in the approach to be taken with regard to fare collection on the Cincinnati streetcar. As this concept is advanced, the allocation can be adjusted accordingly.

**5.07 – Central Control** – An allocation for central control equipment has been included in line item 5.05 (above). As the system is extended, the control and communication systems can be expanded to include new Streetcar vehicles and stops. The equipment is proposed to be located at the MSF, the existing facility within the Riverfront Transit Center (RTC) Operations Center, SORTA's Operations Center, or at the City's Traffic Control Center. These systems would interface with SORTA's "Next Bus" stop enunciators and automatic vehicle location (AVL) systems. On-board AVL equipment for each Streetcar is covered in the per-car cost estimate (Category 7, below).

## **Category 6 – ROW, Land**

**6.01 – Purchase or lease of real estate** – A 2.5 acre site has been presumed to be required for the Cincinnati Streetcar MSF. The cost of the right of way has not been included in the cost of the facility. No per-unit acquisition cost has been identified as of this writing. As a likely site for this facility is determined, the acquisition costs can be added to the estimate. Several sites within existing, publicly owned right of way were identified as potential locations for the MSF. As a result, this estimate does not include the cost of the land for the facility. The proposed track alignment is in publicly held right of way, therefore no cost for the alignment is needed or budgeted.

## **Category 7 – Vehicles**

**7.01 – Streetcars** – Unit pricing for vehicles for the West Sacramento project is based on a replicar-type vehicle. For the Madison project, the unit cost is for an articulated light tram design were used. For the Cincinnati Streetcar evaluation, the Inekon-Skoda car being manufactured in the USA was used as the proposed vehicle. It is the same vehicle acquired for Portland and for the new Anacostia Line in Washington, DC. In discussions with the manufacturer, a current fixed price of \$3.1 million per car was offered for a car order placed with the current specifications, including spare parts, etc. A total of \$200,000 was added to that estimated price to provide for additional features that might be desirable. This additional allocation would also cover on-board AVL







equipment and other provisions that might be desirable for the Cincinnati Streetcar. This results in per-car price of \$3.3 million, which is being used for the Cincinnati estimate. On the basis of needing six cars to cover operating and maintenance requirements, a base year total of \$19.8 million results. Note that the unit price estimated for this assignment is consistent with results obtained on the Albuquerque streetcar project, a slightly larger order, at 10 cars.

## **Category 8 – Soft Costs**

**8.01 – Preliminary Engineering** – The Columbus allocation of 4% of the total construction costs, land costs and vehicle costs for preliminary engineering was felt to be slightly higher than recent experience in the Cincinnati area, however, it was acknowledged that this allocation would provide a conservative result, which could be adjusted as the project advances. The 3% allocation when applied to the Cincinnati results, leads to a base year cost of just under \$1.9 million.

**8.02 – Final Design** – The Columbus allocation of 6% of the total construction costs, land costs and vehicle costs for final design was considered to be low for the Cincinnati project. After discussion, a staff recommendation to use an 8% allocation of this item was adopted, resulting in a base year cost of slightly more than \$5.0 million. This assumes that all engineering and specifications for the Streetcars is included in the cost of the Inekon-Skoda cars as they have already been designed.

**8.04 – Construction Administration and Management** – The Columbus allocation of 8% for this item was considered to be too high, based on recent experience in the Cincinnati area. Prior projects administered by the project team have resulted in CM costs of 3%. Therefore, the allocation was adjusted to 4% to provide a cushion for first time inefficiencies but based on the assumption that the contractor would assume most of this responsibility. When this adjustment was made, a base year cost of just over \$2.5 million resulted.

**8.05 – Insurance, Legal, Permits, etc.** – A common-bonding program or Owner Controlled Insurance Program, as applied on the Fort Washington Way, Great American Ballpark, and Convention Center projects has been assumed. All designers, contractors and suppliers are assumed to have deducted insurance costs and Workers' Compensation expenses from their pricing and applying it to this line item. This reduces the conflicts arising from potential design errors and omissions, contractor delay claims, and other job disruptions. This results in a base year cost of approximately of 1% or \$0.6 million.

**8.06 – Surveys, Testing, etc.** – The Columbus allocation of 3% of the total construction costs, land costs and vehicle costs for surveying and testing was considered to be too high for the Cincinnati project. Engineering layout is allocated in the construction costs. This line item covers only independent owner testing and inspection of materiel and equipment manufactured off site. Accordingly a 2% allocation is applied in this estimate and results in a base year cost of almost \$1.3 million.

**8.07 – Agency Force Account Work** – The Columbus allocation of 4% was considered to be too high for the Cincinnati Streetcar project. Agency and owner costs of supervision and agency





administration not covered in the design, construction management and inspection efforts are reflected in this line item. Therefore, this allocation is reduced to 2% for the Cincinnati assignment, resulting in a base year cost of slightly under \$1.3 million.

### Category 9 – Finance Charges

This line item amounts to 2.5% of the construction subtotal and represents the cost of borrowing money (or issuing bonds, etc.) to finance the project. For the Cincinnati Streetcar project this cost is slightly under \$1.1 million in base year dollars, or when expressed in year of expenditure dollars, just under \$1.3 million. These finance charges are carrying costs during construction only, as debt service during operations is accounted for in the operational budget.

### Category 10 – Contingency

The “Component Contingency Method” was used to determine this allocation. As noted in the text, the project element with the greatest uncertainty is the utility relocation element. The utility relocation unit cost was given a higher price than other locations given the level of design at this time. Further, a larger contingency was applied. Therefore, that line item received a 25% contingency. All other aspects of the project have a greater degree of certainty associated with them (track, stations, MSF and systems elements) so they had a 10% contingency allocated. In the case of the vehicles, the per-car price was quoted by the manufacturer to the project team (\$3.1 million). However, the per-car price entered in the spreadsheet includes an extra \$200,000 per car (total of \$3.3 million), which amounts to a 6% contingency on this line item.

When the contingency is considered as a portion of the sum of the construction costs, land costs and vehicle costs, it amounts to 8.4% of that total cost. As the project planning advances this allocation can be re-evaluated.

**Total Project Cost** – The worksheet sums this automatically. For the Cincinnati Streetcar project, the total project cost is just under \$84 million in 2007 base year dollars. When the year of expenditure escalation to 2010 is considered, the total project cost is almost \$102 million.

**Year of Expenditure Cost per Mile** – The spreadsheet calculates this automatically. Based on the above unit pricing and quantity requirements, the average construction cost per mile (in year of expenditure dollars) is approximately \$11.6 million per mile. The total project cost in year of expenditure dollars is just below \$22 million per mile for the starter segment. This cost per mile includes the vehicles and MSF which would be used for subsequent extensions. This would reduce the per mile cost of these extensions.

**A table showing the itemized estimated capital costs is included on the following pages.**

